Space Weather Technical Forecast

Issued on Friday, 05 November 2021 at 12:03 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of M-class flares. Slight chance of G1/Minor to G2/Moderate geomagnetic storms. Active electron flux and fluence expected.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: There are three sunspot regions on the visible disc with observed solar activity remaining at Low levels with two C-class flares over the past 24 hours. AR2891 (Cao/Beta-Delta) has faded somewhat, but still has a delta area on its largest spot. AR2893 (Cso/Beta) in the northeast quadrant has recently developed an opposite polarity spot. Finally we have AR2894 which has just rotated onto the southeast limb. This appears reasonably active in imagery and has been responsible for some C-class flaring already. It is difficult to classify this close to the limb, but currently appears to be Hsx/Alpha.
No Earth-directed CMEs have been seen in available imagery.

Solar Wind / Geomagnetic Activity: The CME which was observed leaving the Sun early on the 2nd November arrived at Earth around 03/2000 UTC, and over the past 24 hours we have seen a slowly waning influence from this CME.
The solar wind speed, as measured by DSCOVR and ACE at L1, slowly declined from around 700 km/s to just below 600 km/s. Density was mostly at average levels, but reached above average levels, with a peak of 23 ppcc, between between 05/0400-0730 UTC. Total IMF, Bt, was moderate to strong at first, peaking at 16 nT, before declining after 05/0400 UTC to be at weak to moderate levels. The north-south component, Bz, was weakly negative at the start of the period, but soon became firmly positive, with peaks of +12 nT. Phi angle was positive (away from the Sun) to start, rotating to negative around 05/0330 UTC. Geomagnetic activity has been Quiet to Unsettled (Kp 1-3), with a G1/Minor Storm interval 04/1200-1500 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained slightly elevated but below the S1 level. The high energy electron flux (greater than 2 MeV) has been at mostly Moderate levels, with a peak of 837 pfu at 04/1555 UTC. The associated 24-hour electron fluence was below the Active (1e8 integrated pfu) threshold, but on a steady rising trend, with 2.26e7 integrated pfu recorded at 05/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to remain mainly Low through the next four days, but with a continuing slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: Solar wind speeds are expected to ease over the next two days as the CME effects wane. However, elevated wind speeds are likely on Days 3 into 4 (07-08 Nov) due to a possible connection to CH17/+, effectively prolonging the increased wind speeds. Predominantly Quiet to Active geomagnetic activity is expected Days 1 to 3 (05-07 Nov), but there is a waning slight chance of further G1/Minor storms through Days 1-3, with a very slight chance of a G2/Moderate storm on Day 1.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain below the S1 minor storm level, but with just a very slight chance of a

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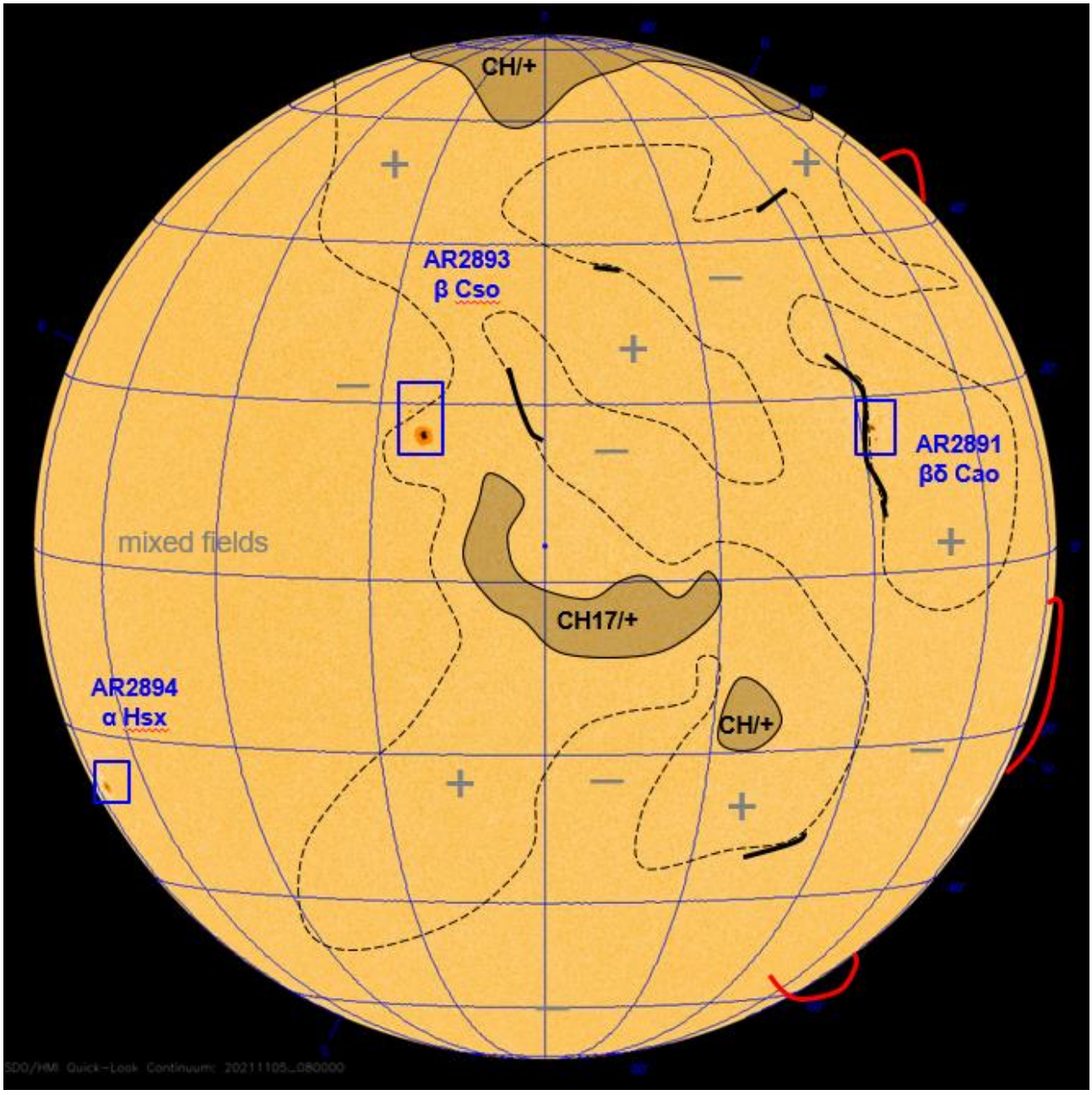
radiation storm if further larger flares occur. The high energy electron flux (greater than 2 MeV) is currently at moderate levels, but is likely to reach high levels through the next 4 days. Corresponding 24 hour electron fluence values are currently below the Active (1e8 integrated pfu) threshold, but are on an increasing trend. The Active threshold is likely to be breached either later Day 1 or on Day 2 (05-06 Nov), and thereafter probably remaining above the threshold.

Figure 1. Solar Analysis Valid 05/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Since the arrival of the CME from 02 November, the solar wind environment has steadily declined, with currently Quiet geomagnetic conditions. However, the solar wind speed remains elevated, therefore any prolonged periods of negative Bz would lead to an increase in geomagnetic activity. Effects from the CME are expected to continue to slowly wane over the next 24-48 hours. No other CMEs are currently expected to arrive.

There is also a coronal hole (CH17/+) just west of centre disc. This feature looks a little different to last rotation (it's further advanced this time around) and last time it was superseded by the arrival of a CME, meaning any forecast is low confidence. However, the most likely arrival time on this rotation is Day 3 (07 November), with a wind speed of 500-550 km/s possible. STEREO-A is showing signs of a HSS arrival at this time. However, wind speeds at Earth may still be slightly raised above background from the waning CME effects, so the HSS could effectively prolong the elevated wind speeds.

Predominantly Quiet to Active geomagnetic activity is expected Days 1 to 3 (05-07 Nov), but there is a waning slight chance of further G1/Minor storms through Days 1-3, with a very slight chance of a G2/Moderate storm on Day 1.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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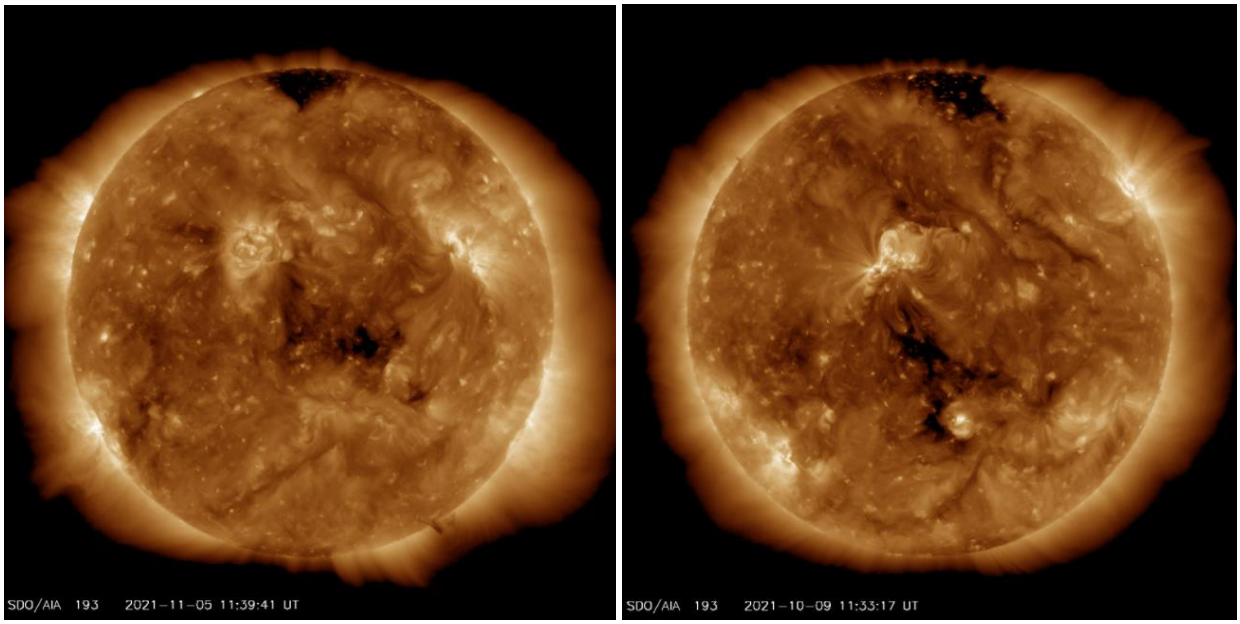
Figure 2: AIA-193 imagery from this rotation (left) showing CH17/+ slightly further ahead than on previous rotation (right).



Radio Blackouts - X-Ray Flares:

There are three numbered sunspot regions on the visible disc: AR2891 (Cao/Beta-Delta) remains the most complex region, although it has faded somewhat in recent hours, it still retains a delta spot within the main spot region. AR2893 in the northeast quadrant has recently developed a weak trailing spot, changing the classification to Cso/Beta. Newly numbered AR2894 has recently rotated onto the southeast limb, and has already produced a C3.5 flare. It is difficult to classify due to its proximity to the limb and currently appears to be Hsx/Alpha, but this may change as it becomes more fully visible. There is also a potential new region visible in STEREO-A EUVI imagery which will rotate onto the northeast limb within the next 24-28 hours. Solar Activity from the numbered regions on the visible disc is expected to be at Low levels, but with a slight chance of isolated M-class flares, mainly from AR2891. The recent fading of AR2891 has been largely balanced out by the increase in complexity of AR2893 and the arrival of AR2894.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	2	2	2	2

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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is now below S1/Minor storm levels. However, further enhancements from significant flaring remain possible.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2 MeV) is currently at moderate levels. However, as a result of the strong solar wind speeds associated with the recent CME arrival, the flux is likely to reach high levels at times on Day 1 (05 Nov) and then predominantly high levels from Day 2 (06 Nov) onwards. Corresponding 24 hour electron fluence values are currently below the Active (1e8 integrated pfu) level, but with an increasing trend. The Active threshold is likely to be breached either later Day 1 or on Day 2, and thereafter probably remaining above the threshold. Therefore the Met Office REFM model is considered to be giving good guidance, although it looks to be rising too quickly.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	60	80	90	90
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	10	20	20

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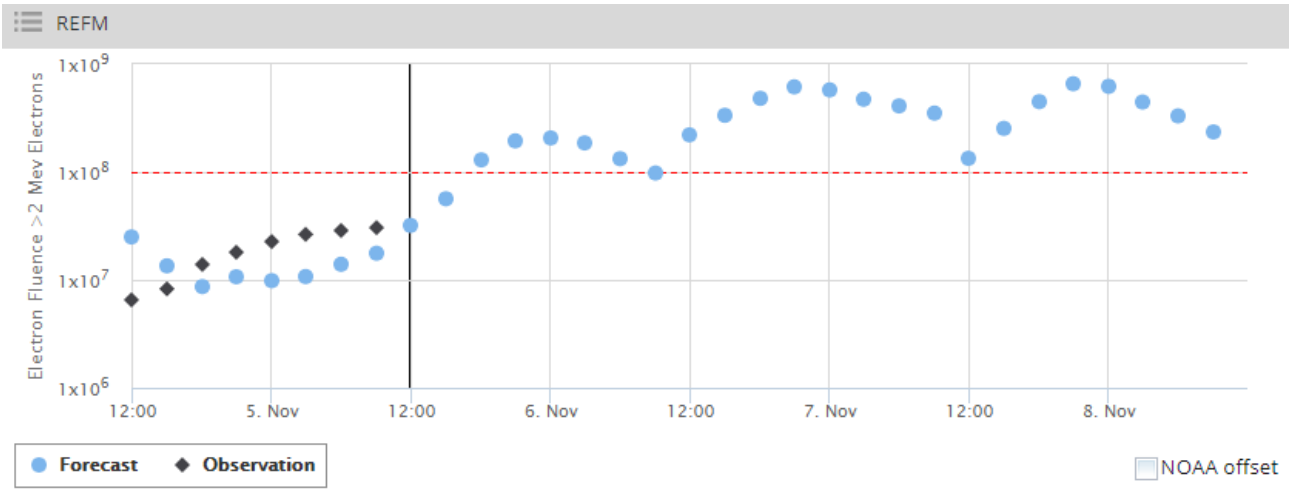
Figure 3: REFM model showing a rising trend, this is considered to be good guidance but slightly too fast.



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